

# Making It Happen

## Implementing Standards-Based Reform in Mathematics Education

“Simply setting new national standards is not enough to transform the teaching and learning that happens in America’s classrooms. If these standards are to serve as an impetus for realizing a new vision of learning in math and science, we must go beyond tinkering around the edges of the current system—adding on this or that program, tacking on additional course requirements, doing more standardized testing, dropping more canned instructional materials at the schoolhouse door. More of the same will yield the same. Instead, we must entirely rethink all levels of the system, so that everything is focused on ultimately supporting classrooms that are learning communities devoted to active, meaningful learning.”

Fennimore and Cook, 1993



# Chapter 7

*“Even if you’re on the right track, you’ll get run over if you just sit there.”*  
Will Rogers

*“The challenge before the nation is to restructure education fundamentally—what is taught, how it is taught, and how we evaluate the results.”*  
MSEB, 1991

*“Change can be likened to a planned journey in a leaky boat on uncharted waters with a mutinous crew.”*  
Fullan, 1993

## Introduction

While the *Minnesota Graduation Standards* are forcing us to reexamine what it means to “do school” and what it means to “do mathematics,” we cannot lose sight of the fact that the purpose of reform is to improve student learning. What must change to raise student achievement? Just about everything:

- mathematics curriculum, instruction, and assessment must be aligned
- teachers’ capacities to deliver effective instruction must expand
- the preparation of mathematics teachers K-12 must be redesigned
- the professionalization of teachers must broaden
- family support systems must stabilize
- students’ motivation to learn and willingness to be taught must increase
- education systems and school programs must be restructured
- policies regarding financing, certification, and accountability must be aligned

“It is [the teachers] who will invent the practice that realizes the vision” (Schifter and Fosnot, 1993) but teachers cannot accomplish reform single-handedly. Teachers are not the sole source of the problems in mathematics education and cannot be the sole agents of change. Change of this magnitude will be messy and will involve levels of discomfort, frustration, and even anger. Real change in mathematics education will require support by the entire community. We must actively engage all those with a stake in improving the mathematics achievement of Minnesota students to move this ambitious agenda forward.

## The Change Process

No recipes or roadmaps currently exist for effectively altering the educational system to improve student learning. Michael Fullan (1993, pp. 19-41) offers eight important lessons for those who are willing to take on the challenge:

### **Lesson 1: You can’t mandate what matters.**

While policy makers have an obligation to establish standards and accountability procedures, teachers and students of mathematics do not and cannot change by simply being told to do so. Mandates must be followed by adequate and appropriate support, information, resources, and time.

### **Lesson 2: Change is a journey, not a blueprint.**

Like life, sometimes things go well in mathematics reform efforts in spite of the questionable decisions we make, and sometimes things go poorly even if we are doing all the right things. Mathematics reform does not come packaged in a multiple-choice format. There is no single right answer for improving the instruction of mathematics teachers or the achievement of mathematics students, but any action or decision that gets us all headed in the same direction will help.

### **Lesson 3: Problems are our friends.**

Conflict is essential in any successful change effort. Problems are at the heart of inquiry, and education reform is the ultimate inquiry effort. The recent reaction in some states against reform efforts based on national standards should not surprise us, but rather motivate us to communicate and defend the case for change.

*"If people don't have their own vision, all they can do is 'sign up' for someone else's. The result is compliance, never commitment."*  
 Senge, 1990

**Lesson 4: Vision and strategic planning come later in the process.**

Ownership in mathematics reform efforts will take time to evolve. "Ready, fire, aim" is a realistic sequence of action in a system undergoing major reform (p. 31). Our mistakes or partial solutions along the way can help us hone realistic mission statements, goals, and strategies to direct our future efforts.

**Lesson 5: Individualism and collectivism must have equal power.**

"Isolation is bad; group dominance is worse" (Fullan, p. 34). There must be a healthy interplay between group and individual efforts to interpret and implement state standards in mathematics. Minnesota's teachers, schools, and districts need to be headed in the same direction but don't all need to be on the same page at the same time.

**Lesson 6: Neither centralization nor decentralization works.**

"Change flourishes in a sandwich. When there is consensus above, and pressure below, things happen" (Pascale quoted in Fullan, p. 37). Minnesota students will benefit from local school and district efforts that are informed by creative thinking, team collaboration, and regular reflection, as long as the personnel at the local level don't lose sight of the central mission expressed in the state graduation standards.

**Lesson 7: Connection with the wider environment is critical.**

It is important for each of us to act locally, continually reexamining our internal assumptions, while understanding our connectedness to the larger system. While one mathematics course with an inspiring teacher can be beneficial, students cannot and will not develop mathematical power without articulation of content and effective instruction across the entire school/district mathematics program.

**Lesson 8: Every person is a change agent.**

The old paradigms of leadership will not budge a system entrenched in the status quo. Each and every person must take responsibility to help create a continuously renewing educational system and mathematics program capable of effecting improved student achievement.

As we move to implement focused and rigorous graduation standards, tensions will arise between state accountability and local autonomy. Fullan's eight lessons suggest that both points of view are necessary. In Minnesota, this can be applied to the productive reform of mathematics education and the increased mathematics achievement of Minnesota students.

*"Local variability is the rule; uniformity is the exception."*  
 McLaughlin in Sashkin & Egermeier, 1993

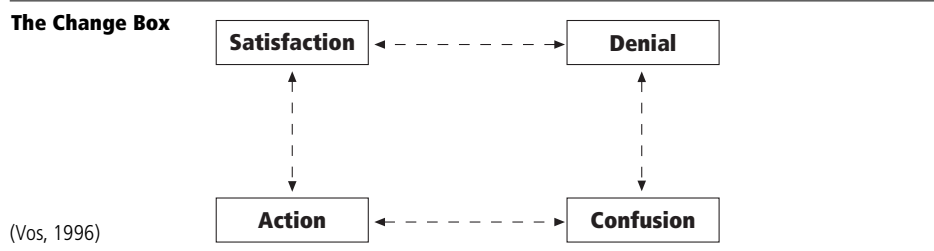
*"Investment in people as the primary agents of change is critical."*  
 Loucks-Horsley et al., 1997

**Individual Change**

In order for systems to change, the individuals in them must be willing to change. Two models, the Change Box and the Concerns-Based Adoption Model, can help us track the stages through which individuals typically cycle as they struggle to adapt to forces in their personal or professional lives.

*"Change is individual and developmental."*  
 Fullan, 1993

**Model 1**



**Figure 1 - The Change Box**

Stage	What you will hear:	What you will see:
<b>Satisfaction</b>	"I feel good about what I'm doing; I'm on the right track."	People in this stage see no serious reason to question what they are doing.
<b>Denial</b>	"There's just so much time in a day. I'll never get that done." "My students are learning; I don't need to change anything."	Someone or something causes a person to question his/her beliefs or actions but there is no personal ownership of the problem at this stage.
<b>Confusion</b>	"What does this mean for me?" "How can I make this fit with what I am already doing?" "How can I manage this?"	People in this stage are beginning to stretch their thinking. Though they may make many false starts, the majority of personal learning occurs at this point in the cycle.
<b>Action</b>	"I can try this." "We can do this." "Let's make this modification."	A decision is consciously made to take some action to alleviate the confusion. This action may, in turn, cause more confusion or a sense of satisfaction.

People enmeshed in changing their beliefs or actions may skip a stage, or move back and forth between two stages as they adjust. For example, a teacher committed to implementing a new standards-based mathematics curriculum may move regularly from being confused to doing something about it, without much sense of satisfaction or denial, for long periods of time. Time is not a constant in this model. Depending on the seriousness of the change forces at hand, a person might get through these stages in two minutes, two days, two months, two years...or never.

**Model 2**

**Concerns-Based Adoption Model**

The Concerns-Based Adoption Model (CBAM) is a conceptual framework that can help people understand and control many of the factors that stimulate or stifle effective change in schools (Hall and Hord, 1987; Hord et al., 1987; Loucks-Horsley, 1989). In this model, seven "stages of concern" have been identified that address how teachers or others perceive an innovation and how they feel about it. These stages appear in Figure 2 in a hierarchical scheme, but individuals rarely move through them in a linear fashion.

The stages can be clustered to reflect three general categories of concern:

**Stages 1 and 2:** Self concerns

Question: What is this new change and how will it affect ME?

**Stage 3:** Task concerns

Questions: How do I do this? What will it take to make this happen for my students?

**Stages 4, 5, and 6:** Impact-oriented concerns

Questions: Are my students learning more and learning better this way? What are others doing? How might we work together?

Again, time in this model is the variable, but the change process necessary for fully implementing an educational innovation, like adopting an integrated mathematics curriculum or implementing

*"Reform is a marathon, not a sprint."*  
Fullan, 1993

graduation standards, takes three to five years at a minimum. Effective and consistent support is necessary at every step along the way:

- *When teachers are first learning about a new practice or program, workshops, demonstrations, observations, and on-site support are needed for teachers to address their self-concern issues. Teacher participation and input is critical while they gather the information they need to commit their time and energy to implementation efforts.*
- *During the implementation process, ongoing follow-up support delivered as close to the classroom as possible is essential. Teachers can quickly give up during this phase if appropriate assistance and encouragement are not available.*
- *Finally, to truly institutionalize new practices, programs, or standards, they must become part of the fabric of the school/district. For this to occur, systems for maintenance and renewal must be established in order to address ongoing questions: How will the organization continue to support and provide leadership for this change? How will new staff be trained? How and when will progress be reviewed and changes recommended?*

*"...You cannot improve student learning for all or most students without improving teacher learning for all or most teachers."*

Fullan, 1996

*"Comprehensive change disrupts past patterns of practice."*

Hessler, 1997

Change is a process, not an event. It is also a highly personal experience for the individuals involved. Change threatens our sense of competence, our sense of control, our self-confidence, and our comfort-level (Loucks-Horsley, 1997). These feelings are neither right nor wrong; they are simply a part of the developmental process that affects both our feelings and our skills. As reform in mathematics education takes hold in Minnesota, we must acknowledge these feelings as an important part of the process, and plan the support mechanisms necessary to help teachers reflect on their practice, examine alternatives, and implement the changes in content, instruction, and assessment that will be necessary to prepare students for successful citizenship in the 21st century.

**Figure 2: CBAM Model Related to Implementing Mathematics Standards**

Adapted from Gann (1993, pp. 287-288)

**Stages of concern**

**Stage 0:  
Awareness**

<b>What you hear:</b>	<b>What you see:</b>	<b>Intervention strategies:</b>
"I don't care about this. Save your breath. It'll go away."	No involvement in anything related to mathematics standards	<ul style="list-style-type: none"> <li>• Acknowledge that a lack of awareness is reasonable and expected and that no questions about the new mathematics standards are "dumb."</li> <li>• Share information that will arouse interest but not be overwhelming.</li> <li>• Expend minimal time and energy trying to "convert" people who are not ready to hear the message.</li> </ul>

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Stage 1:  
Informational  
concerns**

"What is this all about?"	There is interest in getting information about the standards, the assessments, requirements for implementation, and timelines.	<ul style="list-style-type: none"> <li>• Provide clear and accurate information about the mathematics standards in a variety of ways: verbally, in writing, and through any available media.</li> <li>• Help teachers see how implementing the mathematics standards is similar to or different from their current practice.</li> <li>• Be enthusiastic and highlight teachers who have begun implementing the standards in their classrooms or schools.</li> </ul>
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**Stage 2:  
Personal  
concerns**

“How will these mathematics standards directly affect me?”

The individual is concerned about his or her role in the new system. Issues of accountability, decision making, existing commitments, and changes in professional status may emerge.

- Provide encouragement and support while maintaining expectations.
- Acknowledge the existence of personal concerns. Allow for their expression and take time to address them. It can be comforting to know that others share these same concerns.
- Use personal notes and conversations to provide encouragement and reinforce others’ personal adequacy to implement mathematics standards.
- Show how mathematics reform can be implemented progressively over time rather than all at once. Establish expectations about what is realistic and attainable.

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**Stage 3:  
Management  
concerns**

“I am spending all my time managing materials, planning lessons, and doing record keeping.”

Issues related to efficiency, organization, management, scheduling, and time are constantly raised.

- Focus on providing answers to specific “how to” issues and give exact and practical solutions to logistical problems that contribute to management concerns.
- Clarify the components of implementation efforts and focus on one area of change at a time.
- Pay attention to immediate demands involved in implementation; avoid issues pertaining to future impact.

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**Stage 4:  
Consequence  
concerns**

“How will these standards or new curricula affect my students? Will their test scores improve? Will they be prepared for work or college?”

Issues become focused on students, including the relevance of teaching materials, assessment, grading, and program improvement.

- Identify opportunities for teachers at this stage to share their knowledge and skills with others.
- Provide opportunities to visit other schools or classrooms where mathematics standards or new curriculum projects are being implemented.
- Share research information related to student achievement.
- Continue to give individuals at this stage positive feedback and needed support.

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**Stage 5:  
Collaboration  
concerns**

“How can I coordinate what I am doing with others in my department? with the math teachers in our feeder schools?”

Efforts are made to share information with others and coordinate programs of instruction to maximize the impact on students.

- Encourage, but don’t force, collaboration. Devise ways to bring people together, both within and outside of a school/district, who are interested in working collaboratively.
- Encourage these people to offer technical assistance to others who have requested it.
- Provide some individuals with opportunities to develop their collaborative skills.

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**Stage 6:  
Refocusing  
concerns**

“I think there are some changes we could make to do things better.”

Individuals have definite ideas about alternative methods for implementing new directions in mathematics education.

- Find ways in which these individuals can channel their ideas and energies; act effectively on their concerns for program involvement.
- Be willing to accept that these people may significantly modify the existing strategies for implementing reform in mathematics education.

*“Systems’ have a better track record of maintaining the status quo than they have of changing themselves...It is people who change systems, through the development of new critical masses.”*  
Fullan, 1996

### Systemic Reform

Sashkin and Egermeier (1993, p. v) cite four strategies that have influenced educational reform, with mixed results, over the last thirty years:

- **fix the parts:** implement innovative curricula and/or teaching methods
- **fix the people:** improve professional development of teachers
- **fix the schools:** develop the school’s capacity to solve its own problems
- **fix the system:** change the roles, rules and relationships at all levels of the system

The fourth approach is the most recently developed and the most promising. It builds on and incorporates the first three strategies while focusing on comprehensive change. Systemic reform involves “reforming and restructuring the entire enterprise of education, from the level of national goals to state curriculum frameworks, on to the district, the building, the classroom and the teacher” (p. vi). Systemic reform requires at least the following seven consistently cited components (pp. 14-16):

#### 1. Restructuring authority and accountability

The goal of restructuring is to create flexible systems and programs that are capable of encouraging and supporting innovation by:

- giving people at the school-site level authority that is equal to their responsibility (site-based management) while, at the same time, holding them accountable in new and various ways
- changing school governance by giving “voice and choice” to a wider school community, including parents, professional educators, and representatives from the larger community (businesses, foundations, social service agencies, colleges and universities, etc.)

#### 2. Developing meaningful standards of achievement and performance in every curriculum area

These standards provide a common vision and direction for all stakeholders. They are established by developing a broad, national consensus among key stakeholders in a content field, exactly the process used to develop national standards for mathematics and science education.

#### 3. Translating national standards into state curriculum frameworks

These policy documents embed national standards within the state’s cultural and political contexts and give more specific direction to statewide implementation concerns. They are also developed through a consensus process that involves a diverse set of stakeholders, all of whom have high technical expertise.

#### 4. Developing curricula that align with national and state content standards

The goal here is to avoid a project mentality of implementing this course or that textbook. Mathematics (and science) curriculum efforts must be comprehensive and coherent and must be consistent with district goals. They must be developed and implemented within the context of the school district’s policies, programs, teaching goals, and learning outcomes.

#### 5. Changing instruction

The focus of classroom instruction is redirected with an emphasis on the student rather than the delivery system. “Instruction becomes less teacher centered and more student focused, less generic and more personalized, less competitive and more cooperative” (p. 15).

*“Transforming complex social systems involves ‘a mix of persistence, passion, politics, people, and knowledge.’”*

Crandall in Sashkin & Egermeier, 1993

*“The lesson of systemic reform is to look for those strategies that are most likely to mobilize large numbers of people in new directions.”*  
Fullan, 1996

## 6. Developing new assessment strategies

This professional work is centered on the tasks of identifying, developing, and implementing more authentic ways of assessing student performance and progress.

## 7. Empowering teachers

Defining standards of student performance requires a new “connectedness” among teachers. The isolation of teachers must give way to continuing opportunities for teachers to learn from each other: to talk, to listen, and to share results, strategies, and insights. Just as content standards define student outcomes in terms of performance measures, so must teaching contracts define standards of professional performance and outcomes.

Systemic reform is, in essence, a change in culture, a change in how we do school. Why should it be more successful in effecting mathematics and science education reform than previous strategies? There is finally a comprehensive awareness for the need to change at multiple levels of the educational and political system:

- At the international level, the results from the Third International Mathematics and Science Study (TIMSS) have forced a discussion about mathematics and science programs in the United States. These areas of the curriculum have been identified as “a mile wide and an inch deep,” lacking focus and coherence. Comparative studies of videotaped mathematics classrooms in Japan, Germany, and the U.S. give little evidence that standards-based instructional strategies have a foothold in the mathematics classrooms in this country. Major changes are needed in our shallow curriculum and our professional development work if our students are eventually to compete in a global economy.
- At the national level there are six National Education goals developed by the nation’s governors and the President, including Goal 5 which states that “by the year 2000, United States students will be first in the world in mathematics and science achievement.” There is also federal support for states, districts, schools, and communities to develop the capacity they need to undertake and sustain educational reform within the framework of these six goals.
- At the national level there have been funds available from the National Science Foundation (NSF) to support systemic reform efforts to implement national standards in mathematics and science education. State Systemic (SSI), Urban Systemic (USI), and Local Systemic (LSI) Initiative grants have brought important funds into a majority of the fifty states directed at policy and professional development activities. Under the auspices of the Improving America’s Schools Act, administered by the U.S. Department of Education, money is available for mathematics, particularly under Title I (disadvantaged students) and Title II (professional development for teachers).
- At the national level, a series of reports from the Secretary’s Commission on Achieving Necessary Skills (SCANS) has identified the workplace competencies and foundation skills required of workers in the 21st century. Employers at both the national and local levels are citing the SCANS competencies as they push for more advanced study of mathematics, science, and technology for all students.
- At the state level, the *Minnesota Graduation Standards* establish expectations for K-12 education which emphasize the results of the education process. These standards, written for primary, intermediate, middle, and high school levels, outline what students should know and be able to do in order to make progress toward and qualify for high school graduation. In the area of mathematics, students must achieve a certain score on an assessment of basic mathematics skills prior to graduation. In addition, there are five high standards at the high school level explicitly related to mathematics, four at grade eight, and three each at grades five and three. There is also a standard related to mathematical research included in the inquiry standards.

*“That people last tenaciously through policy changes has been a curse of many reform initiatives. That people, once changed, can in fact remain changed, may turn this curse into a blessing. Professional development may sustain systemic reform when change at the system level fails.”*

Loucks-Horsley et al.,  
1997

*"If [school reform] can happen anywhere, it can happen everywhere."*  
Crew, 1997

- At the state level, SciMath<sup>MN</sup> is an established partnership among business, education, and government pursuing statewide improvement in the teaching and learning of K-12 mathematics and science based on national mathematics and science education standards and the *Minnesota Graduation Standards*. SciMath<sup>MN</sup> focuses its efforts in the areas of policy, professional development, and public awareness.
- At the state level, a Best Practice Network of teachers has been selected and trained to support classroom teachers' implementation of the *Minnesota Graduation Standards* and the content standards in this *Framework*. They are committed to promoting best practice in the classroom throughout the state via one on one exchanges, classroom demonstrations, Internet communication, and inservice workshops.
- At the local level there is emphasis on site-based management strategies and increased community involvement in both formal and informal school support and leadership structures.
- At the local level there are scattered but intensive professional development programs in place to support teachers who are implementing standards-based mathematics curriculum programs.

Stakeholders at all levels of the system are agreed that fundamental changes are necessary to produce the capable and thoughtful citizens required for life and work in the next century.

Fundamental changes involve those at the core of schooling: basic conceptions of what it means to know mathematics, reexamination of the roles of teachers and students in constructing that knowledge, and the reorganization of classroom, school, district, and community structures to promote the student learning of mathematics (Elmore, 1996).

### **Roles of Stakeholders**

"It takes a village to raise a child." This popular African proverb is the rallying cry for systemic reform. It summarizes the reality that lasting change in mathematics education requires that work be accomplished at several different levels simultaneously, including the classroom, school, district, community, and policy arena. It requires the collaboration of many stakeholders: teachers, teacher educators, and supervisors of mathematics; principals, superintendents, and school board members; parents, guardians, and other caregivers; business and community leaders; and policy makers and legislative representatives. Individuals working together can make a difference. They can rebel, organize, force issues, threaten the status quo, present the data, and represent the needs of children. There are a number of things that individuals can and must do, knowing that systemic reform is a commitment to change over time, a commitment to working for the next generation. It is crucial that all citizens comprehend and appreciate the stake they have in raising the mathematics achievement of all students. We all have a role to play; now is the time for action.

*"What matters most is local capacity and will."*  
McLaughlin in Sashkin & Egermeier, 1993

### **Note:**

*The following pages focus on various stakeholders. These ideas are intended to spark conversations about actions that community partners might take to support mathematics reform. They are offered as suggestions, not prescriptions.*

**Why should you get involved in mathematics reform?**

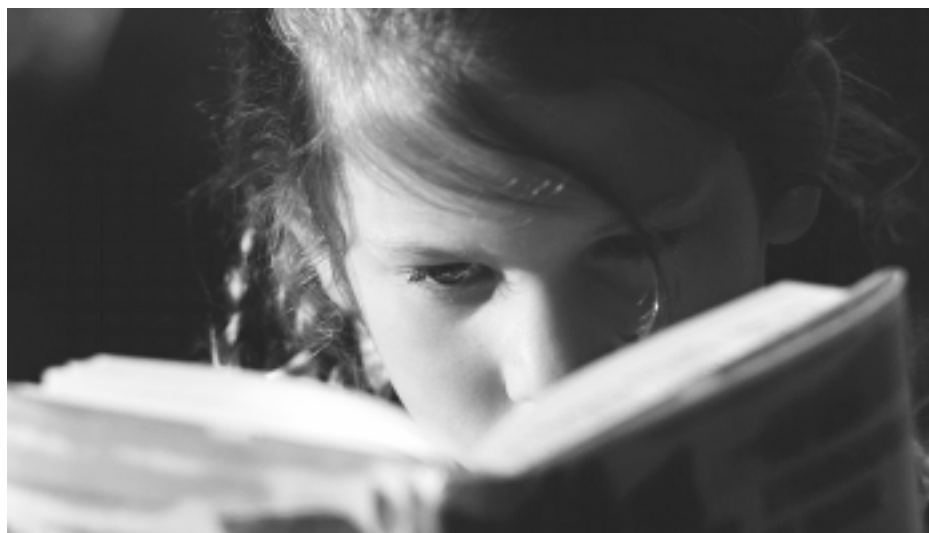
**Focus on Students of Mathematics**

In order to learn mathematics, you will need many opportunities to DO mathematics, to solve problems, to demonstrate your solution strategies, to listen to others' points of view, but the best curriculum and the best teachers in the world will not help you succeed in mathematics unless you accept responsibility for your own learning. Teachers can give you the opportunity to learn new concepts or solve realistic problems, but they can't force you to understand them. In order to learn in productive ways, you need to personally make sense of mathematics.

Most people attend school for 12-20 years, or only about 15%-25% of their entire life. Yet school plays a major role in preparing a person for the rest of his/her life's work. The education your parents received will not be enough to prepare you for the technical jobs of the next century. You will need more mathematics, science, and technology to be prepared for the majority of careers in the workplace. Most people your age will change jobs 7-12 times in a lifetime. You will need to be willing to retrain, to continue to learn new skills and understandings for the rest of your life, for each new job will almost assuredly require new skills.

**What can you do?**

- Talk to your school counselor or interview workers in the community. Find out what mathematics you will need to pursue various jobs or careers.
- Take mathematics every year you are in school.
- Get involved in your learning—do the assignments, ask questions, organize a study group, get help when you don't understand the work.
- Be sure that you have equal access to and opportunity to use high quality learning materials, including electronic sources of information and a variety of technological tools.
- Find out how you learn best—what is your learning style? Take a learning styles survey or think about some of the questions in the section on learning styles in Chapter 2.
- Set aside regular study time at night and on the weekends.
- Set aside a place where you can study that is relatively free of things that distract you.
- Develop your study habits so you can concentrate for longer periods of time.
- Participate in extra-curricular activities as a substitute for more passive pursuits, like watching TV.



**Why should you get involved in mathematics reform?**

**Focus on Parents, Guardians, and other Caregivers**

You are your children's first teacher and role model. Your views about education, school, and the importance of mathematics are the lessons that your children take with them into the classroom. If they believe that mathematics is only for the gifted or the "nerdy" types, or if they believe that it's OK *not* to do well in mathematics because you never liked it either, their opportunity to achieve will be affected.

Your children will need your support and encouragement in making good educational decisions. The workplaces in your community and this state are changing rapidly, depending more and more on sophisticated technology. Learning mathematics opens the doors to many careers and job opportunities. If your children stop taking mathematics too early in their school careers, they will close off many future education and career options.

Educational research consistently shows that when parents actively collaborate with schools in the education of their children, there is a marked improvement in student achievement (Rigden, 1994, p. 28). When children feel secure at home, they bring a natural curiosity and eagerness to learn into the classroom. When they know that their parents or caregivers and their teachers expect them to work hard and succeed, they make a greater effort to learn.

**What can you do?**

- Provide the basics—nutrition, safety, shelter, and a sense of belonging—so your children go to school ready to learn.
- Insist that your children take challenging mathematics courses every year.
- Instill the belief in your children that they can succeed in mathematics.
- Create a home environment that fosters high expectations for learning mathematics.
- Don't repeat old myths about mathematics and science such as, "Boys are better than girls in math and science;" "You're either good at it or you aren't."
- Share with your children how you use mathematics at home or on the job.
- Encourage good study habits by setting a time and place for daily homework and offering help when it is needed.
- Review your children's daily work in mathematics; don't wait for parent-teacher conferences to see if your children are making progress.
- Use criteria such as those found in the brochure, "What Should I Look for in a Math Classroom?" when visiting your children's classrooms (see Appendix).
- Encourage your children to read; let them see you reading; read to them and with them or tell them stories.
- Monitor your children's TV viewing.
- Solve everyday problems and play games together.
- Be sure your children have access to and use calculators, computers, and hands-on mathematics materials, as well as electronic sources of information.
- Participate with your children in mathematics programs sponsored by museums, community centers, clubs, or schools.
- Encourage your PTA to get parents information on up-to-date mathematics materials and teaching strategies; check for these teaching practices in your children's classrooms.

**Why should you get involved in mathematics reform?**

**Focus on Teachers of Mathematics**

The classroom is where the “mathematical rubber hits the road.” If changes in policy, curriculum, instruction, and assessment do not affect student learning in the classroom, the wider community will lose faith that the educational system can adequately prepare students for life in the real world. Your success as a mathematics educator impacts the future education and work options of your students. Your ability (or inability) to implement changes in mathematics content, instruction, and assessment also reflects on your success as a learner.

Your job is to teach the children important mathematics as effectively as possible. Bored students do not learn; students must be engaged in mathematics and challenged if they are going to be motivated to work hard and succeed.

Education reform at the classroom level demands three difficult but inescapable tasks (Rigden, 1994, p. 15). First, you must believe that all students can master the mathematics standards if they are given the opportunity and the necessary support along the K-12 curriculum to do so, and that it is possible for you as a mathematics teacher to help them succeed. Second, you must hold students accountable for learning. Third, you must work together with your colleagues to redesign schools and mathematics curricula to better meet the needs of all students.

**What can you do?**

- Improve your knowledge of and ability to do mathematics.
- Provide a curriculum and a classroom environment that supports students and encourages them to investigate, discuss, and reason about challenging mathematical problems; strongly encourage the participation of all students.
- Use a variety of instructional tools, such as textbooks, math manipulatives, calculators, computer software, TV programs, and videos, that will promote student learning.
- Increase your knowledge of students’ cultural backgrounds and incorporate the contributions of various cultures into units of study.
- Select and use curriculum materials, lessons, and assessments that are aligned with the mathematics standards, are free of bias, and are sensitive to diverse student populations.
- Provide students access to and opportunities with appropriate technology.
- Assess student work against the high standards, and when students have difficulty learning, provide additional support and help.
- Reflect regularly on your practice; be sure you can justify your instructional decisions to yourself and to others.
- Use more than one type of assessment tool when assessing students’ work; use comparisons of performance over time to assess an individual student’s achievement.
- Help students see and make connections among different mathematical strands, and from mathematics to other disciplines and to daily life.
- Encourage students to continue to take challenging mathematics courses throughout their school career.
- Prepare a personal professional development plan covering a period of at least three years.
- Read research and professional journal articles in mathematics education.
- Collaborate with your colleagues as you participate in short-term and long-term professional development programs related to the teaching and learning of mathematics.
- Join and participate in professional organizations.
- Use video and print materials to inform parents, colleagues, and administrators about mathematics education reform.

### Focus on School Principals

#### Why should you get involved in mathematics reform?

You are the person whom parents, caregivers, and the wider community hold accountable for providing a relevant and challenging mathematics program. You are the educational representative to the wider school community, including those in the business/industry sector who will employ your students in the future.

As the school program's instructional leader, you are responsible for helping teachers understand the reasons behind the need for mathematics reform and the steps necessary to implement it. You have a crucial role in designing the staff development that will be necessary to implement the *Minnesota Graduation Standards* and to help students learn rigorous mathematics. As other disciplines develop national standards and state frameworks, the professional development work you do in mathematics can be a guide for implementing standards-based change throughout your school program.

While moving through your program, students develop lasting impressions about their personal worth, their intellectual abilities, their social skills, and their prospects for future success. As a result of the experiences students have in your program, many of them will opt in or opt out of future study in mathematics, thereby defining their career options for a lifetime.

Site-based management strategies work best "when directed by a wise, flexible leader with an unswerving conviction that student learning is the primary work of schools" (Rigden, 1994, p. 20). Teachers look to you for vision, encouragement, and guidance. In your position, you can set the tone for progress, or become a roadblock to mathematics reform.

#### What can you do?

- Build a program that will ultimately nurture increased student achievement in mathematics.
- Hold all students accountable for learning mathematics; work to eliminate tracking plans that deny student access to meaningful programs of mathematics instruction.
- Encourage and reward teachers who are willing to implement research-based content and instructional practices in teaching mathematics.
- Hire knowledgeable teachers adept at teaching mathematics in ways that invite all students to learn; value and promote the hiring and retention of staff from underrepresented groups.
- Identify and support mentors for new, inexperienced teachers of mathematics.
- Use criteria such as those found in the brochure, "What Should I Look for in a Math Classroom?" when visiting classrooms and evaluating the performance of teachers (see Appendix B).
- Work with staff to plan a long-term professional development effort aimed at aligning mathematics curriculum, instruction, and assessment with state standards and this *Framework*.
- Integrate equity issues into professional development activities; provide opportunities for staff members to examine their beliefs about and expectations for all students.
- Support professional development on implementing appropriate technologies in the mathematics curriculum.
- Base decisions about technology and teaching resources, scheduling, and the use and maintenance of school facilities on their capacity to enhance the quality of teaching and learning.
- Link your school's mathematics curriculum efforts with that of your feeder schools to provide a smooth transition and a more coherent and focused program of instruction for your students.
- Keep parents and community members informed about changes taking place in the mathematics program; invite parents and business/community partners to join the school improvement team and to come into the school to speak about the role of mathematics in the workplace.

**Why should you get involved in mathematics reform?**

**Focus on District Administrators/Supervisors**

The school board and community hold you accountable for the district's educational program and its implementation of state standards in mathematics. You are the person responsible for communicating the whys and wherefores of mathematics reform to diverse stakeholders: teachers, principals, parents, policy makers, and the wider community. Principals and teachers look to you for guidance and support in addressing their mathematics needs at the school level. Site-based reforms cannot be maintained long-term without your active support and encouragement.

You need to understand mathematics reform in order to establish flexible policies and procedures to promote and encourage site-based change and innovation; to develop assessment strategies that effectively measure not only how well students reach high standards but also how well schools educate their students; and to create communication and resource networks for the schools in your district (Rigden, 1994, p. 8).

You need to have up-to-date information to guide the review and possible modification of mathematics curriculum and assessment in the district, and be able to respond to questions from the school board and community arising from comparisons of student performance.

**What can you do?**

- Hold students accountable for learning.
- Set up data collection and analysis systems to track student achievement in mathematics; share that information with administrators, teachers, and community members in helpful ways.
- Work with teachers to define a core K-12 curriculum, identify grade level outcomes, and provide access to effective mathematics materials, including up-to-date texts, calculators, and computers.
- Offer technical assistance to support the decision-making role of faculty and administrators at the school sites.
- Provide personnel who have mathematics expertise and leadership skills to support K-12 teachers in curriculum, instruction, and assessment; give them adequate resources for their work.
- Actively generate and promote policies that address issues of equity in mathematics education.
- Align budget allocations with mathematics reform efforts.
- Link financial and technical support to school accountability.
- Communicate the vision for mathematics reform to your school board and your community.
- Set up structures to support full-scale implementation of successful programs.
- Direct staff development toward teams of teachers, not isolated individuals; aim long-term staff development efforts at the school-site whenever possible.
- Allocate resources to address issues of equity in all program areas.
- Provide funds to help schools redesign for technology access and application.
- Develop vehicles to enhance community involvement in the mathematics achievement of students.
- Fund and develop after-school programs in mathematics.

**Why should you get involved in mathematics reform?**

**Focus on School Board Members**

The taxpayers in your community hold you accountable for overseeing an educational program that prepares students for the responsibilities of gainful employment and citizenship in the community. You set the policies and direct the actions of school personnel that include the alignment and improvement of mathematics content, instruction, and assessment.

You are a major advocate for and representative of parents and caregivers. You should be able to cogently explain and justify to them proposed changes in the mathematics program and act effectively to ensure that those changes result in improved student learning.

You are also the school system representative for adults in the community who do not have children in the schools. You must be able to convince this larger group of the need to expend limited resources on mathematics reform efforts.

**What can you do?**

- Encourage a positive, supportive climate in your district that is conducive to change and teacher growth.
- Build the *Minnesota Graduation Standards* into your district's educational mission and goal statements.
- Request information on the current mathematics program and its affect on student achievement.
- Work with the superintendent, mathematics supervisor, and mathematics teachers to develop a long-term plan to align the district's curriculum with the state's high standards and this *Framework*.
- Make resources for ongoing professional development a priority in your district budgets.
- Request periodic updates on the progress of mathematics reform in your district. Request information from multiple sources—do not rely solely on standardized test data.
- Review district policies to identify those that may serve as roadblocks to reform efforts.
- Align policies and practices to ensure that staff and administration respect and promote diversity.
- Be visible in the schools; stay in touch with classroom teachers in the district.
- Consider ways in which to restructure the school day in order to provide adequate time and focused attention for professional development and enhanced student learning.
- Stay informed on mathematics reform perspectives at both the state and national levels.
- Engage the community in discussions related to mathematics reform.

**Why should you get involved in mathematics reform?**

**Focus on Community Members**

There is growing recognition that in order to reach our national education goals, there must be a shared consensus around education issues. Changes within classrooms, schools, and districts will demand closer collaborations between families and schools, including connections to social service agencies and other community resources (Rigden, 1994, p. 27).

The effectiveness of your neighborhood schools in raising student achievement in mathematics is an indicator of the strength of your community. Schools and families in your community need your input and assistance in doing this work.

**What can you do?**

- Advocate funding for early childhood programs in your community.
- Advocate for high quality programs of mathematics instruction in your neighborhood schools.
- Monitor the mathematics achievement of students in your neighborhood schools; track their achievement on the standards-based assessments at grades 3 and 5, their passing rates on the assessment of basic skills at grade 8, their demonstration of progress on the graduation standards, and their high school graduation rates.
- Help schools develop creative ways to communicate and collaborate with families.
- Work with school and district representatives to coordinate some of the services to and interactions with students and their families.
- Fund and develop after-school programs in mathematics.
- Sponsor town meetings to discuss mathematics reform issues.
- Host functions to foster partnerships between schools and community agencies.
- Provide opportunities for students in your community to learn about, understand, and value their own culture and the cultures of others.
- Mentor individual students as to career possibilities and future opportunities.
- Support programs to increase the capacity of parents to support the mathematics achievement of their children.
- Support community-based centers for activity and service programs for child care, teenagers, and adult literacy programs.



**Why should you get involved in mathematics reform?**

**Focus on Business Leaders**

Your company needs competent employees to increase production and profits. You need graduates who can think well, use mathematics and technology in their work, communicate clearly (both orally and in writing), and adapt to changing situations. Academic achievement and the ability to work collaboratively with others are your priorities for employees (Rigden, 1994, p. 5). These are all crucial elements in the reform of mathematics instruction.

Jobs in the future will demand a much stronger academic foundation than before. For most entry-level jobs in industry, including the construction and manufacturing trades, students need the same algebra, geometry, physics, and trigonometry they would need for college (Rigden, 1994, p. 6). There are no unskilled jobs on the factory floor anymore. In addition, the three most frequently used math skills in today's workplace are statistical regression, critical-path analysis, and linear programming (Hart, 1997). The mathematics in the graduation standards adequately prepares Minnesota students for these workplace applications. There are few entry-level jobs available for students who cannot show progress toward the graduation standards in mathematics.

Business-sponsored programs will not reform schools by themselves, but they can be a catalyst for change. Business can effectively provide the "enabling conditions"—time, vision, student-focus, leadership, and outside support—that will lead to long-term change (Rigden, 1994, p. 14).

**What can you do?**

- Hold students accountable for learning—establish hiring policies that help students understand the importance of education by valuing the breadth and difficulty of courses taken as well as grades received.
- Develop structured work apprenticeship programs that link academic courses with on-the-job experiences to effectively prepare students for the workplace.
- Provide scholarships and other incentives for academic success.
- Mentor individual students as to career possibilities and future opportunities.
- Become familiar with the concerns of local teachers.
- Invite teachers into your company during summer or sabbatical months for job-related experiences.
- Volunteer to show teachers and students how mathematics is used in your business to solve problems.
- Help parent-employees understand the need for mathematics reform and its future impact on their children and on the workplace.
- Create flex-time and other policies that permit school visits; provide paid leave for parents to participate in school activities.
- Support community and educational programs that increase the capacity of parents to support the academic achievement of their children.
- Encourage employees to serve on local and state education task forces and to become active in their local school
- Provide management consultants and advisors to principals and district leaders.
- Work with school counselors to be sure that they have timely information regarding the mathematics skills needed for current and future jobs.

**Why should you get involved in mathematics reform?**

**Focus on Teacher Educators**

Minnesota is currently developing a new teacher licensure system that emphasizes teachers' knowledge and competencies instead of the present course-based system. Upon graduation, Minnesota's teacher education students will be expected to teach a mathematics curriculum that is aligned with national standards, state graduation standards, and this *Framework*. In order to be licensed and seek a teaching position, teacher education candidates will need a deep understanding of mathematics content, the ability to implement effective teaching strategies that support student inquiry and problem solving, and the desire to continue to grow professionally. They will also benefit from a sense of the history and future of mathematics, an ability to support the learning of students with diverse linguistic, ethnic/racial, and socioeconomic backgrounds, and an ability and desire to use technology appropriately in their instruction. "Teachers well prepared for the mathematics classrooms of the 21st century will need preparation that is very different from what is offered at most institutions today" (INTASC, 1995, p. 72).

**What can you do?**

- Keep current with the reform recommendations in national documents, including those issued by the Mathematical Association of America (MAA), the National Board for Professional Teaching Standards (NBPTS), and the Interstate New Teacher Assessment and Support Consortium (INTASC).
- Keep current with documents that impact K-12 mathematics education reform, including the *Curriculum and Evaluation Standards for School Mathematics* (NCTM), the *Professional Standards for Teaching Mathematics* (NCTM), the *Assessment Standards for School Mathematics* (NCTM), the *Minnesota Graduation Standards*, and this *Framework*.
- Form a study group to read and discuss the Minnesota document for teacher education programs, *Transforming Teacher Education: A Minnesota Framework for Mathematics and Science*.
- Talk to classroom teachers about their concerns in implementing the state standards for mathematics and to better understand their perceptions about the knowledge, understandings, and skills that incoming teachers will need to implement standards-based mathematics.
- Support standards-based professional development at the graduate level.
- Work to ensure that your teacher education students understand the why, what, and how of mathematics standards, and have experience planning and delivering standards-based curricula before they enter the teaching workforce.
- Teach your education students how to select and use curriculum materials, lessons, and assessments that are free of bias, are sensitive to diverse student populations, and address the different learning needs of students.
- Provide students access to appropriate technology resources.
- Provide a learning environment in your program and on your campus that encourages and supports the participation and success of students from diverse backgrounds in becoming educators.
- Actively recruit faculty, students, administrators, and support personnel from underrepresented groups.
- Encourage student membership and involvement in state and national professional groups.
- Recognize that the professional development of beginning teachers is a shared responsibility of the entire education community. Find vehicles by which members of your institution can effectively partner with practicing teachers and other personnel in K-12 schools, school districts, state agencies, and professional organizations.

### Why should you get involved in mathematics reform?

#### Focus on Policy Makers

The public expects more from their schools in exchange for the tax dollars that are invested in education. It expects state education policies to provide direction and accountability for the entire education system. You have the legal responsibility to establish state policies that ensure that education programs reflect both the current and future needs of all students.

Mathematics, science, and technology play important roles in the economic vitality and viability of our state's businesses and industries. If Minnesota employers cannot find adequate mathematical skills among the graduates of our public schools, they will look elsewhere for an educated workforce. Clear national and state standards in mathematics exist to inform the preparation of a technical workforce in Minnesota.

It is a myth that changing policy is the best way to change schools. "...unless there is local will for change and local capacity for change, mandates for reform issued by governors, legislators, professional educators, or broad-based community coalitions have little or no impact within classrooms, schools, and districts" (Rigden, 1994, p. 11). To have any effect, policies must be followed by concerted efforts to build local capacity for reform at the district and school level. Your personal, political, and financial support for in-depth and ongoing professional development in mathematics education is crucial.

### What can you do?

- Support the establishment of state standards in mathematics and advocate for their achievement at high levels.
- Support a long-term commitment to graduation standards; avoid the two-year "shelf life" of legislative policies.
- Budget adequate financial resources for assessment to measure how well our educational investment is paying off.
- Support a state accountability system that promotes new assessment strategies. New content standards in mathematics require a new breadth of knowledge and thinking skills beyond those that can be measured by standardized tests. Authentic assessment techniques must be developed and employed, including those that incorporate open-ended problem solving items and the use of calculators.
- Support adequate and appropriate state-level resources and technical assistance to support reform in mathematics education; offer incentives to promote and nurture local efforts directed at increasing student achievement toward the high standards.
- Ensure adequate educational opportunities for all students.
- Streamline and simplify the operation of school systems.
- Support legislation and state funding for effective, long-term professional development efforts.
- Support funding that will improve facilities to complement the teaching and learning in restructured schools, including wiring for technology access and use, flexible instructional spaces, and materials/spaces to support the professional capacity of teachers.
- Communicate with mathematics educators and representatives of their professional organizations to become better informed about the issues in the reform of mathematics education.
- Recognize that change in education is accomplished gradually, and that effective change demands stable policies, adequate resources, and a consistent commitment to ongoing, long-term professional development.

**Why should you get involved in mathematics reform?**

**Focus on Members of the Media**

While the majority of citizens in this country feel the public schools are failing, they tend to rate their own children's schools quite favorably. It has been suggested that this discrepancy in the assessment of school performance is a result of the negative educational landscape portrayed in the media (Elam et al., 1994).

Minnesota's citizens get most of their information from the media, which wields a tremendous amount of political and social power. Your members shape public opinion on a wide range of issues, including education. Your customers look to you to cover newsworthy issues in a balanced and in-depth approach. The reform in mathematics education has created controversy and disagreement in other areas of the country. You need to be prepared to understand the issues and to communicate them reasonably and fairly.

**What can you do?**

- Help explain the importance of mathematics to the economic vitality and viability of both the state and the country.
- Highlight the changing needs for technical skills in the workplace, including entry level jobs.
- Sponsor town meetings to discuss mathematics reform issues.
- Sponsor education reform supplements in the newspaper to adequately communicate to the public the elements of the *Minnesota Graduation Standards* in mathematics as well as other areas.
- Provide more coverage of events that highlight mathematics achievement, including mathematics contest winners at the local, state, and national levels.
- Highlight the efforts of successful teachers in mathematics—teachers who help all students achieve in mathematics, not just the gifted and talented students.
- Highlight business and education partnerships that provide work experiences for both students and teachers.
- Commit resources to continue in-depth coverage of important educational issues, including graduation standards and the time allocated to core academics.



*“Each of us must come to care about everyone else’s children. We must recognize that the welfare of our children and grandchildren is intimately linked to the welfare of all other people’s children. After all, when one of our children needs lifesaving surgery, someone else’s child will perform it. If one of our children is threatened or harmed by violence, someone else’s child will be responsible for the violent act. The good life for your own children can be secured only if a good life is also secured for all other people’s children.”*

Lillian Katz

### Summary

No one believes that systemic reform of mathematics and science education will be accomplished quickly or easily. We are still experimenting with school-based management procedures. We are still searching for new assessment tools to effectively measure student learning. We are still developing comprehensive and consistent professional development models. We are still trying to find effective ways to “scale-up” restructuring efforts to support the learning of students in a majority of schools. But this time reform will happen. It will take:

- the dedicated work of teachers and staff willing to rethink educational priorities and school practices
- the support and encouragement of educators and administrators within the system
- the knowledgeable support from families and community/business leaders
- the thoughtful development of state and national policies that undergird reform initiatives (Rigden, 1994, p. 12)

In the end, systemic reform will be driven by those at the local, state, and national levels who believe that all students can learn mathematics and science, and who have the will and determination to get the job done. When changes within schools, districts, communities, and education policies support mathematics classroom reforms that are influenced by innovations in content, instruction, and assessment, then the system will be transformed. Then, and only then, will each and every student have the opportunity to achieve an excellent mathematics education.



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